

May 27, 1924.

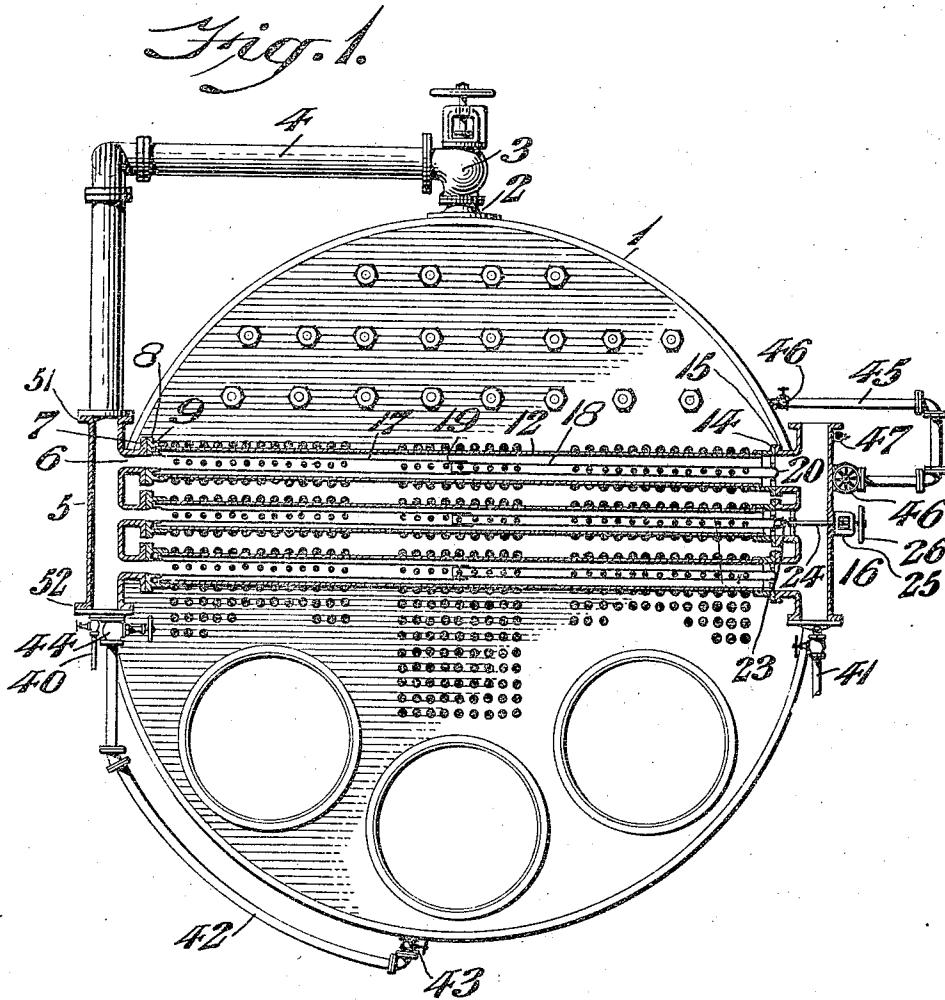
J. S. MILNE ET AL

1,495,760

STEAM SUPERHEATER

Filed Oct. 20, 1919

3 Sheets-Sheet 1



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May 27, 1924.

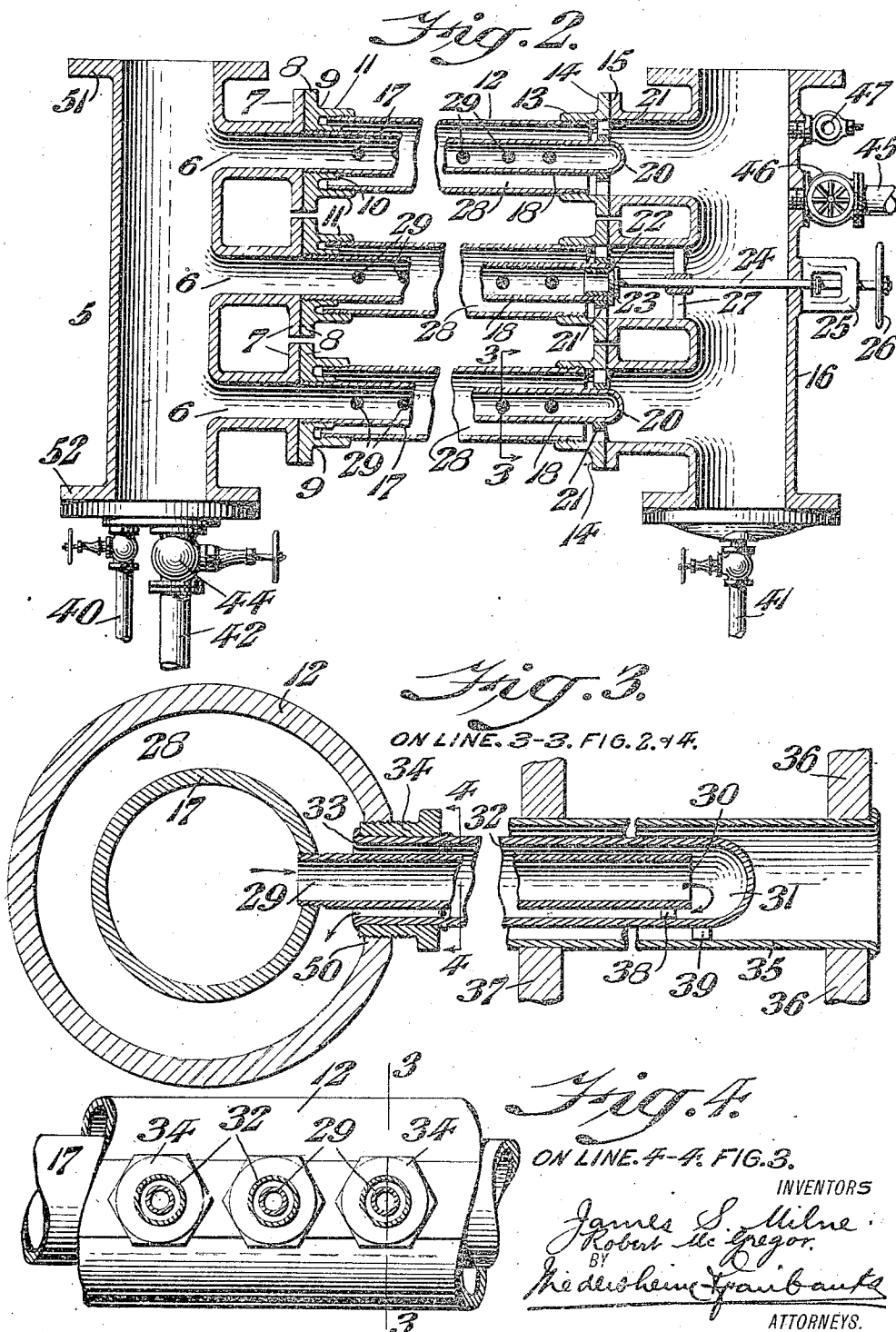
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STEAM SUPERHEATER

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3 Sheets-Sheet 2



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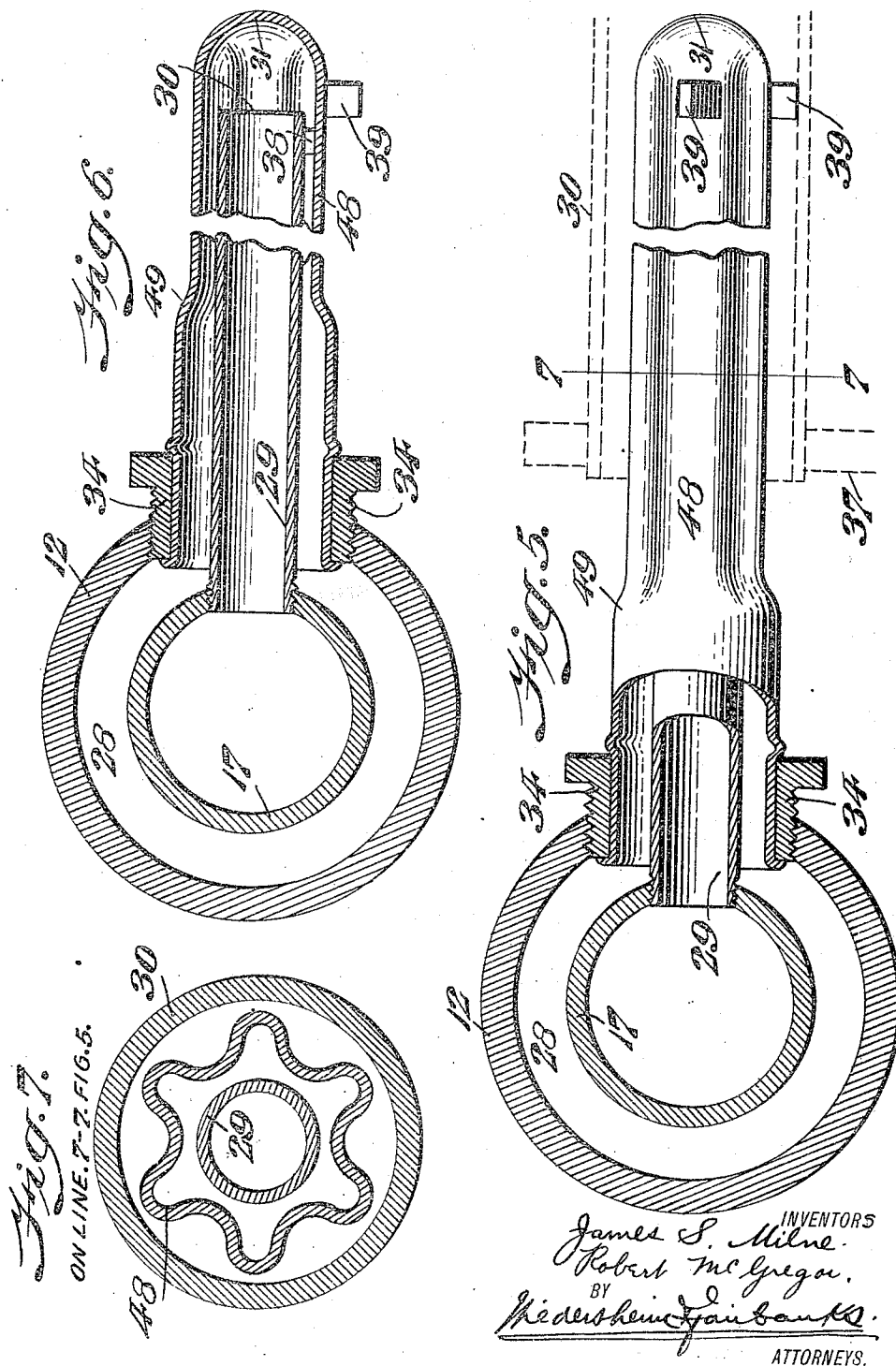
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STEAM SUPERHEATER

Filed Oct. 20, 1919

3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE.

JAMES S. MILNE, OF BROOKLYN, NEW YORK, AND ROBERT MCGREGOR, OF MONTCLAIR,
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STEAM SUPERHEATER.

Application filed October 20, 1919. Serial No. 332,108.

To all whom it may concern:

Be it known that we, JAMES S. MILNE, a citizen of the United States, residing at Brooklyn, county of Kings, State of New York, and ROBERT MCGREGOR, a citizen of the United States, residing at Montclair, county of Essex, State of New Jersey, have invented a new and useful Steam Superheater, of which the following is a specification.

Our invention consists of a novel construction of steam superheater which is adapted to existing boilers without necessitating any change or dismantling of the latter, or employment of special fire tubes, provision being made for readily and expeditiously assembling the superheating devices with respect to any desired group of fire tubes in an existing boiler.

To the above ends, our invention consists of a novel construction of an inlet manifold adapted to be secured to novel coupling members each of which receives the end of a tubular outer header and a tubular saturated steam main, all of which can be cheaply constructed and readily installed in position with respect to any standard fire tube boiler and being further conveniently accessible at all times for the purposes of inspection, replacement and repairs.

It further consists of a novel construction of outlet manifold carrying a valve for admitting saturated steam to the superheated steam when desired, said manifold carrying coupling members which are provided with spiders or centering devices for supporting the contiguous ends of the saturated steam mains, the opposite or inlet ends of said mains being supported in the novel coupling members aforesaid, secured to said inlet manifold.

It further consists of a novel construction of a tubular superheated steam header or main, an internal preferably cylindrical saturated steam main arranged concentrically within it, an outer superheating tube open at one end and closed at the opposite end and having its open end secured to a thimble threaded into said header, said superheater tube being collocated in a novel manner with a saturated steam circulating tube, arranged concentrically within it and properly positioned or centered with respect

thereto, means being also provided for properly positioning said outer or superheating tubes with respect to the surrounding fire tube, whereby the relatively coolest steam is conveyed to the hottest part of the superheating tube, thereby reducing the temperature of said tube at this point.

It further consists of a novel construction of a saturated steam main wherein the cross-sectional area of said main decreases from its inlet end to its terminus, the ends of said main being supported and centered with respect to the outer header in a novel manner.

It further consists of a novel construction and collocation of a saturated steam main supported in a novel manner and having one or more valvular manually-operated devices, whereby a predetermined amount of saturated steam can be admitted when desired, or according to requirements, to the superheated steam preferably in the outlet manifold, for the purpose of reducing the temperature of said superheated steam, when desired or expedient.

It further consists of a novel construction and arrangement of water circulating pipes so collocated with respect to the boiler proper and our novel inlet and outlet manifolds, that said superheater when desired can be temporarily flooded with water from the boilers, which will circulate through the superheater during the time of raising steam, provision being further made for readily and expeditiously draining the superheater or its manifolds according to requirements.

It further consists of a novel manner of collocating and assembling the superheater elements, whereby the inner and outer circulating and superheating tubes can be readily assembled or disconnected from the header sections, according to requirements or for the purposes of inspection, replacement or repair.

It further consists of a novel manner of collocating each superheater element with respect to its inclosing standard fire tube so that the operation of cleaning or the blowing out of the fire tube is not interfered with in any manner.

It further consists of a novel construction of corrugated outer or superheating tube having one end closed and the other

open, whereby the effective heating surface or area is increased in conjunction with a thimble in which said open end is secured, said thimble being screwed into the outer

or superheater main.

To the above ends, our invention consists of a novel construction of steam superheater, wherein all the tubes are straight and return bends are dispensed with, thereby reducing friction and permitting any degree of superheat to be obtained by adding additional rows of tubes, and wherein a minimum number of joints are employed, thereby reducing the liability of leakage.

For the purpose of illustrating our invention, we have shown in the accompanying drawings certain forms thereof which are at present preferred by us, since the same will give in practice satisfactory and reliable results, although it is to be understood that the various instrumentalities of which our invention consists can be variously arranged and organized and that our invention is not limited to the precise arrangement and organization of these instrumentalities as herein shown and described.

Figure 1 represents a front elevation of a Scotch or marine boiler showing our novel construction of steam superheater applied thereto, the boiler casing being removed.

Figure 2 represents, on an enlarged scale, a vertical section of the superheater proper and its adjuncts, certain of the parts being shown in elevation.

Figure 3 represents a section on line 3—3 of Figures 2 and 4.

Figure 4 represents a section on line 4—4 of Figure 3.

Figure 5 represents, on an enlarged scale, a side elevation of our novel corrugated superheater tube, the saturated steam main, header, circulating tube and coupling nipple, being shown in section.

Figure 6 represents a longitudinal sectional view of the parts seen in Figure 5, showing the inner circulating tube and the outer corrugated superheater tube in section.

Figure 7 represents a section on line 7—7 of Figure 5.

Similar numerals of reference indicate corresponding parts.

Referring to the drawings.

Our novel construction of steam superheater is adapted to be readily and expeditiously installed in any standard fire tube boiler without any change or alteration of the fire tubes thereof and in the present instance, we have elected to show our novel superheater as applied to a Scotch marine boiler 1, having the steam outlet 2, controlled by the valve 3 leading to the main steam pipe 4, whereby saturated steam is conveyed to the inlet manifold 5, which is

provided with a plurality of outlets 6, which we have shown as three in the present instance, which can obviously be varied, according to requirements.

Each outlet 6 is preferably flanged as indicated at 7 and has secured to it the flange 8 of the coupling member 9 which has the annular internally threaded concentric inner and outer walls 10 and 11, respectively, as will be best understood from Figure 2.

12 designates an outer pipe or superheated steam main or header having one end as its left-hand end in threaded engagement with the outer annular wall 11, the opposite end of said pipe being in threaded engagement with the interiorly threaded annular wall 13 of the flanged coupling member 14, which is secured to the flange 15 of the outlet manifold 16.

17 designates the saturated steam main, which is at one end in threaded engagement with the annular wall 10 and, as shown in Figures 1 and 2, is preferably made in two sections as 17 and 18, the section 18 being of lesser cross-sectional area than the section 17 and the juxtaposed inner contiguous ends of said sections meet at 19, at about the center of the superheater as seen in Figure 1, and are secured together in any suitable manner. When three superheater elements are employed as seen in Figures 1 and 2, we preferably close the outer or right-hand ends 20 of the upper and lower saturated steam main sections 18 which are supported or centered in the spider 21, while the outer or right-hand end of the central saturated steam main section 18 (also supported in a similar spider) is open and formed with a valve seat 22, controlled by the valve 23, which has the elongated valve stem 24, mounted in the yoke 25, secured to the outer wall of the outlet manifold 16, said valve stem 24 being provided with a hand wheel 26, and being supported intermediately of its ends in the spider 27. The inner and outer pipe sections or superheated steam mains and saturated steam mains 12 and 17, respectively, are concentrically arranged, so that an annular superheated steam chamber 28 is formed between them and the manner of effecting the superheating of the saturated steam prior to its entrance to said chamber 28 will now be described, reference being had to Figure 3.

Saturated steam after entering the saturated steam main 17 passes into the inner or circulating tube 29 and flows through the outer or right-hand end 30 thereof into the chamber 31 formed within the closed outer end of the outer or superheater tube 32, whose inner portion 33 is secured in any suitable or conventional manner to the thimble 34, which is exteriorly threaded and in threaded engagement with the threaded

holes 50 in the superheated steam main 12, said superheating tube 32 being concentrically arranged within the fire tube 35 which is secured within the tube sheets 36 and 37 in any suitable manner.

In order to position or center the inner or circulating tube 29 with respect to the outer or superheating tube 32, we provide the outer or radial lugs 38, while said superheater tube 32 is positioned with respect to the fire tube 35 by similar outer or radial lugs 39 best seen in Figure 3. The inlet manifold 5 is provided with a valved drain pipe 40 and the outlet manifold 16 is provided with a similar valved drain pipe 41, so that said manifolds can be readily drained when required.

42 designates a water circulating pipe having a valve 43 in its lower portion, which is connected with the bottom of the boiler 1, as will be understood from Figure 1, while its upper end is connected with the inlet manifold 5 and provided with a valve 44.

45 designates a water circulating pipe having its lower end provided with a valve 46 and connected preferably to the upper portion of the outlet manifold 16, the upper end of said pipe being connected to the upper portion of the boiler 1 and provided with a valve 46, the object of said water circulating pipes 42 and 45 being to temporarily flood the superheater with water, when steam is being raised, so as to prevent burning of the superheater tubes, the superheater being readily drained by the drains 40 and 41.

47 designates a safety valve attached to the outlet manifold 16.

In the construction seen in Figures 5 to 7 inclusive, the saturated steam main 17, the superheated steam main 12, the circulating tube 29 and the nipple 34 are constructed similar to the construction seen in Figures 3 and 4 already described, but in lieu of the plain superheater tube 32 seen in said figures, we employ the corrugated tube 48 whose construction in cross-section will be apparent from Figure 7, said tube being provided with the longitudinal corrugations which preferably extend from its closed end to about the point 49, where the tube is kept cylindrical for convenience in expanding its open end into the nipple thimble or coupling member 34.

It will be apparent to those skilled in the art that our novel construction of superheater and its adjuncts wherein the principal elements are tubular enables the same not only to be cheaply manufactured at a minimum expense but also enables the same to be rapidly and expeditiously assembled or installed in place with respect to the groups of fire tubes of the boiler, without altering or removing said fire tubes.

By making the header or superheater

steam main 12 tubular or out of a length of standard pipe which can be readily cut to the desired length and by drilling and tapping the row of holes 50 therein which receive the thimbles 34, the labor of assembling the superheater tubes 32 and their thimbles 34 with respect to the header 12 is reduced to a minimum.

By making the saturated steam main 17 out of a length of standard pipe cut to the desired length and drilling and tapping the row of holes which receive the threaded ends of the circulating tubes 29, the labor of assembling said circulating tubes with respect to the saturated steam main 17 is reduced to a minimum, and when the ends of said mains 12 and 17 are secured within their coupling members, as best seen in Figure 2, the saturated steam main accurately positions itself with respect to the outer header 12 and the spiders 21 retain the outer ends of said saturated steam main accurately and effectively in position.

By making the inlet passage of the inlet manifold 5 straight and providing said manifold with the flanges 51 and 52, either of said flanges can be used as the top or bottom flange, so that said inlet manifold can be readily assembled with respect to the superheater elements by unskilled labor.

The plurality of coupling members 9 seen at the left of Figure 2 are duplicates, as are the plurality of coupling members 14 seen at the right of said figure, so that they can be cheaply produced or machined in quantities.

Our novel construction of coupling members 9, which receive the ends of the tubular header and the tubular saturated steam main, cause said header and main to be properly positioned with respect to each other when they are screwed in place, and the spiders 21 carried by the right-hand coupling members 14 enable the right-hand ends of the saturated steam mains to be quickly and expeditiously and properly positioned with respect to the outlet manifold. The thimbles 34 can be cheaply manufactured in quantities and are readily screwed in position or assembled with respect to the main 12 by the application of a wrench or other suitable implement thereto.

The employment of the radial lugs 39 on the outer ends of the superheater tubes enables the latter to be readily positioned with respect to the fire tubes 35, and the radial outer lugs 38 on the outer ends of the circulating tubes 29 cause the latter to properly position themselves within the superheater tubes 32, as will be understood from Figure 3.

The operation is as follows:—

Saturated steam generated by the boiler passes through the connection 2, stop valve 3 and main steam pipe 4 to the inlet mani-

fold 5, and then enters the saturated steam main 17 and flows through circulating tubes 29 into the superheating tubes 32. The flow is reversed in the superheating tubes 32, and the steam passes backwardly between the outside of said circulating tube and the inside of said superheating tube back into an annular chamber 28 between the saturated steam header 17 and the main header 12.

The above operation which has been described with respect to one pair of tubes takes place in the plurality of tubes seen extending across the entire front of the boiler in Figure 1.

From the foregoing, it will be seen that from the time the steam leaves the circulating tube 29 and enters the superheating tube, it absorbs a considerable quantity of heat while passing between these tubes, said tubes 32 being centrally located in the fire tubes 35 of the boiler and preferably running to within about six inches of the combustion chamber end of said fire tubes, so that the gases of combustion travel between the outer periphery of the superheater tubes 32 and the inner periphery of the fire tubes 35 on their way to the stack. These gases or products of combustion are obviously hottest at about the point 31 where the relatively cool saturated steam first comes in contact with the superheating surfaces of the superheater tube 32. The superheated steam passes down the chamber 28 between the header 12 and the saturated steam main 17 into the outlet manifold 16, from whence it is conveyed to any desired point. The small by-pass valve 23, best seen at the right of Figure 2, which is preferably located at the end of the central saturated steam main 29, can be conveniently manipulated from the exterior of the outlet manifold 16 to moderate the temperature of superheat to any desired degree, since it will be apparent that should the degree of superheat be higher than desired, said valve 23 can be opened slightly, thereby permitting the saturated steam to flow directly into the outlet manifold 16, mixing therein with the superheated steam and reducing the temperature thereof to any degree desired.

The valve 47 is preferably a small spring-loaded safety valve, which is fitted at some convenient point on the outlet manifold 16, preferably at the upper portion thereof, to relieve excessive pressure within the superheater, which might be caused by closing the throttle valve on the engine and at the same time closing the main stop valve 3 on the boiler, in which event, the safety valve would function.

By opening the proper valves in the pipes 42 and 45 the entire superheater unit can be flooded with water up to the boiler water level, which is desirable when it is desired to circulate water through the superheater

unit, while steam is being raised in the boiler, it being apparent that the presence of water in the superheater when steam is being raised in the boilers, precludes the possibility of burning the ends of the superheater tubes, and it will be further apparent to those skilled in this art that this feature of circulating the water in the superheater permits the raising of steam in a shorter time than heretofore. As soon as steam has been generated within the boiler to the desired extent, the valves in the pipes 42 and 45 are closed and the valves in the drain pipes 40 and 41 opened, thereby permitting the superheater to be emptied or drained, whereupon it can perform its function as a superheater.

It will be apparent that the broad principle of our invention as seen for example in Figure 2, can be employed in other devices, such as feed water heaters and the like.

We desire to also call special attention to the reduction in transverse section as from left to right, of the saturated steam main 17, which reduction increases the effective area between the outside of said main and the inside of the header 12, said area being smallest at the extreme left and gradually increasing in size until its maximum at the extreme right of Figures 1 and 2, where the greatest amount of steam must pass in order to enter the outlet manifold 16.

In Figures 1 and 2, we have shown said saturated steam main as composed of two sections 17 and 18, the cross-sectional area of 18 being of lesser diameter than the section 17, as will be understood also from Figure 2, but it will be apparent that in lieu of the two sections shown in Figure 1, we may make said saturated steam main of three or more sections, whose cross-sectional area gradually tapers or is reduced from left to right or from the inlet end to the right-hand terminus.

It will now be apparent that we have devised a novel and useful steam superheater, which embodies the features of advantage enumerated as desirable in the statement of the invention and the above description, and while we have, in the present instance, shown and described preferred embodiments thereof which will give in practice satisfactory and reliable results, it is to be understood that the same is susceptible of modification in various particulars without departing from the spirit or scope of the invention or sacrificing any of its advantages.

Having thus described our invention what we claim as new and desire to secure by Letters Patent, is:—

1. In a superheater, a threaded coupling, a header, a saturated steam main located within said header, said header and main being screwed into said coupling, and said main tapering from its inlet end to its ter-

minus, and steam superheating devices common to said header and saturated steam main.

2. In a steam superheater, an inlet manifold, a coupling secured thereto and provided with inner and outer annular interiorly threaded concentric walls, an outlet manifold, a coupling secured thereto provided with an annular interiorly threaded wall and a spider, a header in threaded engagement with said couplings, a saturated steam main located within said header and having its inlet end secured to said first-mentioned coupling and its terminus supported in said spider, and superheating devices common to said header and saturated steam main.

3. In a steam superheater, an inlet manifold, a coupling secured thereto and provided with inner and outer annular interiorly threaded concentric walls, an outlet manifold, a coupling secured thereto provided

with an annular interiorly threaded wall and a spider, a header in threaded engagement with said couplings, a saturated steam main located within said header and having its inlet end secured to said first-mentioned coupling and its terminus supported in said spider, open-ended circulating tubes secured in said saturated steam main, and superheating tubes surrounding said circulating tubes and having one of their ends connected to thimbles screwed into said header, the opposite ends of said superheater tubes being closed, whereby saturated steam flows from said circulating tubes into said superheating tubes and then backwards to the chamber between said saturated steam main and header.

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Witnesses:

R. J. VANDERWENDE,
GEO. P. HAYNES.